

## SPECIFICATION

### **Preformed Styrofoam Utility Pipe/Conduit Weight Credit Support Unit**

#### 001 TITLE OF INVENTION

See Above

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#### 002 CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

#### 003 STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

#### 004 REFERENCE TO SEQUENCE LISTING , A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

Not Applicable

#### 005 BACKGROUND OF INVENTION

The invention is related to the soil mechanics, foundation engineering, utility pipe/conduit system designs and construction thereof. Specifically the invention allows the facilitation of utility pipe/conduit installation under conditions where the character and bearing conditions of the soil and/or foundation materials are not conducive for standard types of installations; or where the use of the invention allows for substantial savings in installation costs where the character and bearing conditions of the soil/foundation materials in lieu of standard more expensive types of construction methods. The invention replaces the use of typical reinforced concrete

cradles supported by piles or caissons or open cut installations requiring cofferdams, sheeting and dewatering. The invention when properly designed could even “float” a utility line on open waters with proper anchorage/mooring.

The invention can also be used simply as a foundation cushion for the utility pipe/conduit system to protect the asset from potential damage in installations where the site foundation material is craggy, rocky, boulder or cobble strewn, or simply anywhere uneven protrusions occur in the foundation material that may inflict damaging point loads on the utility pipe/conduit system.

Table 005 indicates a summary of improvements over standard installation methods that the invention provides.

A sample computation of Styrofoam weight credit analysis is attached in order to demonstrate the mathematical and physical theories governing the phenomena of the invention. A 12-inch diameter ductile iron pipe is illustrated in a trench cross section bedded, for the sake of simplicity, on a rectangular Styrofoam section 24-inches thick. The water table is at ground surface for the submerged computation with accompanied stress distribution diagram, and at the base of the Styrofoam bedding in the “dry” state. In both cases there are no appreciable stress increases on the underlying organic silt—therefore, no net settlement due to the additional load resulting from the utility/pipe conduit installation. The computations are attached as page 8 of this document.

Table  
005

Application	Old Method	New Method and Benefits/Improvements
Installation of utility pipe/conduit in unstable soils, eg, peat, organic clays or silts, etc.	Preconsolidation by surcharging the sensitive stratum with placement of temporary overburden loads.  OR  Construct reinforced concrete cradles supported on pile or caisson foundation.	Construct utility pipe/conduit system using the Styrofoam cradles using open cut methods. Benefit: cost and time savings due to comparative ease of construction.
Eliminate additional net load on sensitive soil stratum due to weight of utility pipe/conduit loading.	Excavate overburden to point of zero net loading.	Utilize the lighter density Styrofoam cradle to obtain the weight credit required. Benefit: cost and time savings due to comparative ease of construction.
High water table or open water utility pipe/conduit installation.	Strap to piles or caissons firmly anchored into suitable foundation material.	Low density of Styrofoam cradle allows for "floatation" of utility pipe/conduit system in high water table situations or on open waters. Benefit: Need for expensive foundation eliminated, resulting in cost and time savings.
Rough bedding conditions where point loading can damage utility pipe/conduit system.	Excavate additional depth, backfill with acceptable bedding material such as sand, gravel, crushed stone, etc.	Use of cradle provides cushion for underside of utility pipe/conduit system. Benefit: Savings in cost and time by eliminating the need for extra depth excavation and soil bedding.

#### 006 BRIEF SUMMARY OF THE INVENTION

The invention allows for the facilitation of pipe/utility installation under conditions where the character and bearing capacity of the soil and foundation materials are not conducive for standard types of installation. The Styrofoam cradle upon which the utility pipe/conduit is bedded provides a weight credit displacement over the in situ soil/foundation material allowing additional loading capacity. The object of the invention is to provide a cost savings advantage over standard methods for the construction of utility pipe/conduit systems in unstable foundation materials.

#### 007 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The 8.5"X11" ink drawing on white paper entitled "Preformed Styrofoam Utility Pipe/Conduit Weight Credit Support Unit" dated 5<sup>th</sup> November 2002 indicates a plan view of a typical unit with a Section I-I cut showing a circular pipe supported by the low density Styrofoam unit.

#### 008 DETAILED DESCRIPTION OF THE INVENTION

The invention, a cradle composed of preformed Styrofoam, provides a weight credit benefit in utility pipe/conduit installations in unstable soil conditions by displacing the in situ material with the lightweight Styrofoam when the units are utilized.

The Styrofoam cradle device can be mass produced by qualified Styrofoam products manufacturers by molding, extrusion, or other means or processes in standard lengths and cross sections. The units shall be sized to fit most common utility pipe/conduit systems in current use; or the units could even be custom

manufactured for specific applications in order to meet the desired dimensions of an engineering design. A suitable Styrofoam material that can be considered for this application is an ASTM C 578, Type IV foam with a compressive strength of 25 pounds per square inch and a density of approximately 1.5 pounds per cubic foot. Dow Chemical Corporation is one of the leading manufacturers of Styrofoam. There are other types of Styrofoam that could be considered for this application.

#### 009 CLAIMS

1. The Styrofoam utility pipe/conduit cradle device provides for continuous and uniform support for linear pipe/conduit installations where the in situ soil conditions are such that the net additional gravity load from the pipe/conduit could cause settlement, differential or otherwise, resulting in vertical discontinuity of the utility pipe/conduit system which can cause breakage, open joints, or other deformation.
2. The extreme light density of the Styrofoam cradle when installed below the ground surface provides for a “weight-credit” simply by volumetric substitution of the displaced more dense native soil with the light weight Styrofoam; thus with a proper engineering design, diminishing in all or to some degree, the additional gravity load and surcharge imposed on the subsurface soil material by the overlying utility pipe/conduit system. The end result is significant reduction or even total elimination of potential settlement/subsidence of the utility pipe/conduit system installation.
3. The natural buoyancy of the light-weight Styrofoam material allows for additional support of utility pipe/conduit systems in high water table soil conditions or even

in open waters much like a raft; thus eliminating the need for complex and expensive pilings, caissons or other conventional foundations/method-of-support. The utility piping/conduit systems with proper engineering design can be fully and uniformly supported in the Styrofoam cradle in the high water table conditions of marshes, swamps, wetlands, etc., anywhere the submerged soil conditions are of unfavorable bearing capacity.

#### 010 ABSTRACT

The device and method for construction of linear utility pipe/conduit in adverse soil conditions where instability, low bearing capacity or high water table challenges are overcome by the use of linear Styrofoam “weight-credit” cradles. It provides a marked improvement over standard methods of utility pipe/conduit installation in unstable foundation materials. The cradles can also be simply used as a cushion to protect the utility installation against point loads that could be inflicted as a result of unfavorable foundation conditions.

The device is manufactured from Styrofoam material suitable for subterranean and subaqueous installations. Cross-sectional dimensions can be adjusted according to the specific application depending on the physical properties of the pipe/conduit and the soil parameters where the system is to be installed. In essence the cradle is manufactured as a pre-formed unit extending usually to the spring-line of the pipe/conduit to facilitate acceptance of the pipe/conduit and to provide a stable platform and support for the full length of the pipe/conduit section. The cradles are generally installed in the trenches first, then the pipe/conduit section is placed into the cradle and joined to the adjacent

pipe/conduit section. The width and thickness of the cradle is a function functionally determined as part an engineering design of the pipe/conduit system.

#### 011 DRAWINGS

One 8.5X11 inch black ink on white paper drawing is attached entitled "Preformed Styrofoam Utility Pipe/Conduit Weight Credit Support Unit" dated 5<sup>th</sup> November 2002.

#### 012 OATH OR DECLARATION

Form PTO/SB/01A(10-1) is completed and attached hereto.

#### 013 SEQUENCE LISTING

Not Applicable

#### 014 OBTAINING A RECEIPT FOR DOCUMENTS MAILED TO USPTO

A stamped self-addressed post card is attached to the first page of these documents providing a detailed list that identifies each type of document and the number of pages of each document.

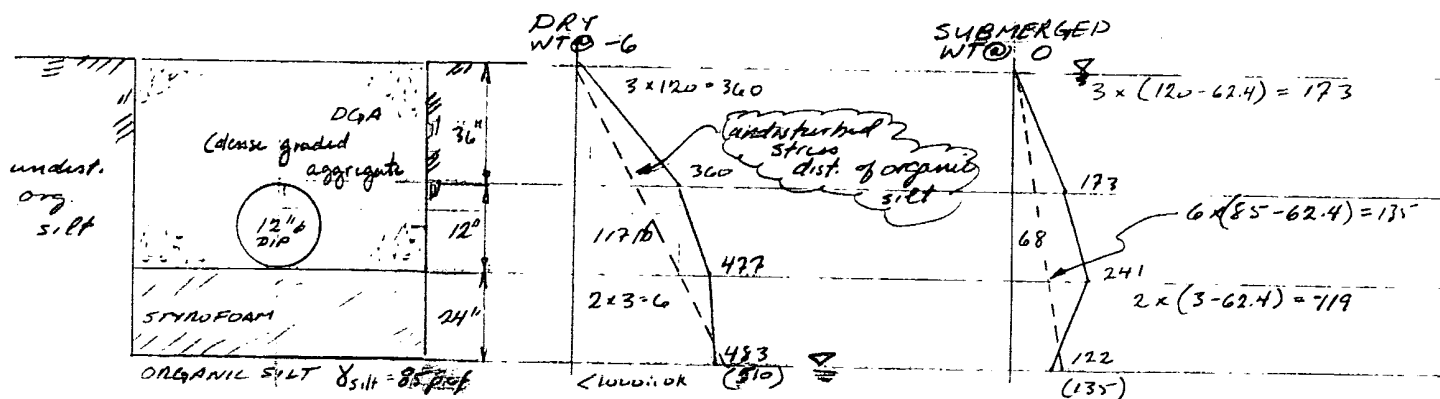
SEE "SAMPLE COMPUTATION OF STYROFOAM 'WEIGHT CREDIT' ANALYSIS" BELOW

ANALYSIS" BELOW



13-782 500 SHEETS FULLER 5 SQUARE  
42-281 50 SHEETS EYE-EASER 5 SQUARE  
42-302 100 SHEETS EYE-EASER 5 SQUARE  
42-303 100 SHEETS EYE-EASER 5 SQUARE  
42-304 100 RECYCLED WHITE 5 SQUARE  
42-305 100 RECYCLED WHITE 5 SQUARE  
MADE IN U.S.A.

# SAMPLE COMPUTATION OF STYROFOAM "WEIGHT CREDIT" ANALYSIS



BASIS:  $\gamma_{DGA} = 120 \text{ pcf}$   
 $W_{\text{pipe}} = 67.5 + 49(N_{60}) = 117.16 \text{ lb/lf}$   
 $\gamma_s = 3 \text{ pcf}$   
 $\text{styrofoam: } \gamma_{\text{styro}} = 1.8 \text{ TSF} + 2 = 0.9 \text{ TSF (1800 lb/cf)}$   
 $\text{org silt } \gamma_{\text{all}} = 0.5 \text{ TSF or } 1000 \text{ lb/cf}$

Since in both "dry" and submerged cases the SP due to inc. in load is actually slightly negative, no settlement is anticipated.

KEY:  $\nabla$  - LEVEL OF WATER TABLE

PREPARED BY:  
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End of Specification